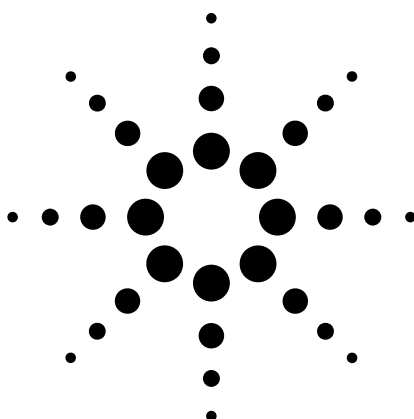




Analysis of Beverage-Grade Carbon Dioxide



**Turnkey configurations for
gas chromatographic
analysis, including
instrumentation, methods,
supplies and service.**



Agilent Technologies

Innovating the HP Way



Agilent Technologies' analyzers for the hydrocarbon processing industry incorporate our extensive industry expertise in creating application-specific measurement solutions, based on standard or custom configurations of gas chromatographs, supplies, and methods, complemented by the specific knowledge of our channel partners

Carbon dioxide, used in the production of carbonated soft drinks and other beverages, can be produced by a variety of sources, including ammonia plants, fermentation plants, chemical plants, and oil refineries. Requirements for purity demand that CO₂ suppliers produce certified contamination-free gas and that beverage manufacturers be able to test and ensure carbonation quality.

The list of possible trace contaminants in beverage carbon dioxide contains a broad spectrum of components from simple gases such as hydrogen and oxygen to heavy hydrocarbons such as pump oils. An appropriate selection of detectors for the gas chromatograph ensures the required sensitivity and selectivity for the specific analysis.

Analyzers from Agilent Technologies incorporate industry expertise and comprehensive systems that are focused on this application.

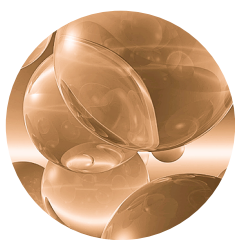
Important benefits ensured by our systems include:

- Comprehensive analysis—flexibility in one system to analyze for components of interest today and expandability to meet your growing needs in the future
- Reliability
- Speed of analysis
- Resolution between components of interest
- System flexibility—analyze from a few components to a full range
- Guaranteed turnkey operation

Agilent Technologies analyzers for beverage-grade carbon dioxide are based on the 6890 gas chromatograph/MSD system, with standard or customized subsystems and software optimized for this application. We have broad expertise in these analyses, and extensive experience in valved gas chromatography, with standard and customized configurations. Our capability is complemented by the industry-specific experience of our partner, Wasson-ECE, Inc. All systems use Windows®-based software, with full data handling capabilities to facilitate communication within laboratory and plant-wide data systems.

Analysis Examples

This booklet contains some examples of specific analyzer configurations. Many more are possible, including the one that will fit your particular analytical needs.



Beverage–Grade CO₂ Quality Assurance

Application 475-00

One particular configuration we have designed for carbon dioxide analysis uses a chromatograph equipped with a mass selective detector (MSD), a flame ionization detector (FID) and a thermal conductivity detector (TCD).

The FID is an excellent choice for volatile C₁ to C₆ paraffin and olefin quantification as well as heavy hydrocarbon (oils) and ethylene glycol quantification. Separation and detection are straightforward with two columns, and calibration is easy due to the FID’s predictable response per weight (mass) hydrocarbon concentration.

The TCD, with its own dedicated column set, is used for the analysis of light gases such as hydrogen, oxygen, nitrogen, and carbon monoxide.

The MSD is used to quantify all other analytes. The power of the MSD is two-fold. First, in the selected ion monitoring (SIM) mode, this extremely sensitive detector can measure in the parts-per-billion (ppb) concentration range. Second, because the MSD is programmed to respond only to a known molecular fragmentation pattern, or spectrum, at any given time, it can confirm the presence of each analyte in question rather than

relying on chromatogram retention time only. This is very important since impurities have different product impact thresholds. For example, paraffin hydrocarbons are acceptable at a level of 20 parts-per-million (ppm) concentration, while benzene has a maximum limit of 20 ppb or 1000 times lower concentration. Without the confirmation power of the MSD, it is possible to accidentally confuse the presence of a low impact analyte with that of a more serious, priority analyte, generating a false-positive report.

Analyte	MDL Mol ppm	Calibration Level Mol ppm
Oxygen*	30	30
Argon*	30	30
Nitrogen	60	60
C ₁ -C ₆ Paraffins	20	20
C ₁ -C ₆ Olefins	5	5
Ethylene glycol	10	10
Non-volatile hydrocarbons e.g. pump oils used in pumping stations for CO ₂	5	10
Carbon Monoxide	5	5

MDL: Minimum Detection Limit
*Oxygen and argon are a single, composite peak without sub-ambient GC oven temperature operation.



Beverage–Grade CO₂ Quality Assurance

Application 470-20

Analyte	MDL Level	Calibration
Hydrogen cyanide	0.25	1
t-Butanol	1	5
Phosphine	0.3	1
n-Butanol	1	5
Nitric oxide*	2	5
Hydrogen sulfide	0.1	1
Nitrogen dioxide*	2	5
Carbonyl sulfide	0.1	1
Benzene	0.02	0.1
Sulfur dioxide	1	5
Ammonia	2	10
Methyl mercaptan	0.05	0.1
Ethylene oxide	0.4	1
Ethyl mercaptan	0.05	0.1
Vinyl chloride	0.35	1
i-Propyl mercaptan	0.05	0.1
Acetaldehyde	0.2	1
n-Propyl mercaptan	0.05	0.1
Propionaldehyde	1	1
i-Butyl mercaptan	0.05	0.1
Acetone	1	1
t-Butyl mercaptan	0.05	0.1
Ethyl acetate	1	1
sec butyl mercaptan	0.05	0.1
i-Amyl acetate	1	1
n-Butyl mercaptan	0.05	0.1
Methyl ethyl ether	1	1
Methyl sulfide	0.05	0.1

Analyte	MDL Level	Calibration
Methyl ether	1	1
Ethyl sulfide	0.05	0.1
Methanol	10	10
n-Propyl sulfide	0.05	0.1
Ethanol	10	10
n-Butyl sulfide	0.05	0.1
i-Propanol	1	5
Methyl disulfide	0.05	0.1
n-Propanol	1	5
Ethyl disulfide	0.05	0.1
i-Butanol	1	5
n-Propyl disulfide	0.05	0.1
Helium	30	30
n-Butyl disulfide	0.05	0.1
Hydrogen	30	30
Methyl ethyl sulfide	0.05	0.1
t-Amyl mercaptan	0.05	0.1

MDL: Minimum Detection Limit, mole ppm
Cal Lvl: Calibration Level
*Best effort on NOx due to component reactivity; Colorimetric Detector Tube may be required



Industry-Specific Answers

Take advantage of the industry expertise that's available to you from Agilent Technologies and our partners. We can provide the answer to your chemical analysis requirements.

Ask Agilent Technologies

Let's talk about your analysis requirements for beverage-grade carbon dioxide. Contact your Agilent representative or authorized distributor. Or for more information, visit www.agilent.com/chem. Help us help you analyze your world.

A Solution Partnership

Agilent Technologies' channel partners complement our expertise in the hydrocarbon processing industry. Wasson-ECE is an Agilent Technologies Premier Solution Provider, a partnership that helps provide you with the most comprehensive analyzer solutions. Wasson's expertise in producing innovative solutions to support the hydrocarbon processing industry will greatly complement Agilent Technologies' products and knowledge.

Windows® is a registered trademark of Microsoft Corporation

© Copyright 2001
Agilent Technologies
January 26, 2001
5988-1944EN